COMPACT AUTO-BALANCING TRANSPORTATION DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/790,301, filed Jan. 9, 2019, entitled Self-Balancing Personal Vehicles, and having Ywanne Ying Chen as inventor.

FIELD OF THE INVENTION

[0002] The present invention relates to auto-balancing transportation devices and, more specifically, to compact form and reduced cost manufacture in hover board type auto-balancing devices.

BACKGROUND OF THE INVENTION

[0003] The prior art includes several auto-balancing transport devices. These include the Segway, developed by Kamen et al and disclosed in U.S. Pat. No. 6,302,230 (among others), the Solowheel, by Chen (U.S. Pat. No. 8,807,250) and Hovertrak, also by Chen (U.S. Pat. No. 8,738,278). These three patents are hereby incorporated by reference as though disclosed in their entirety herein.

[0004] With respect to the Hovertrak of the '278 patent, this device has become popular. A need exists, however, for a device like that of the '278 patent, yet that is more compact and in which the components are more strategically arranged, particularly the battery, wheels and support structure. A need also exists to reduce the cost of manufacturing compared to prior art devices and fabrication techniques.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to overcome shortcomings of the prior art.

[0006] It is another object of the present invention to provide an auto-balancing transportation device with more compact form.

[0007] It is also an object of the present invention to provide a hover board type device with the battery located between the foot platforms and the wheels under the foot platforms.

[0008] These and related objects of the present invention are achieved by use of a compact form auto-balancing device as described herein.

[0009] The attainment of the foregoing and related advantages and features of the invention should be more readily apparent to those skilled in the art, after review of the following more detailed description of the invention taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a perspective view of an auto-balancing device **10** in accordance with the present invention.

[0011] FIG. **2** is a cut-away view that shows the inter-coupling of the left side housing with the right side housing.

[0012] FIG. **3** illustrates, in partial cross-section, the device of FIGS. **1-2** yet with an alternative bearing arrangement.

[0013] FIGS. **4-5** show an alternative embodiment for coupling the two platform sections.

[0014] FIGS. **6-7** show yet another embodiment for coupling the two platform sections.

[0015] FIG. **8** shows an embodiment similar to that of FIGS. **6-7** yet with two different sized bearings.

DETAILED DESCRIPTION

[0016] Referring to FIG. **1**, a perspective view of an auto-balancing device **10** in accordance with the present invention is shown. Device **10** is similar to the auto-balancing device of the '287 patent, for example, they are both auto-balancing devices in which a rider stands facing forward.

[0017] Device **10** may include two wheels **21,31**, foot platforms **22,32**, two motors **23,33**, two fore-aft tilt angle position sensors **24,34**, such as a gyroscopic sensor, control circuit **45** and battery **48**. The left and right portions **20,30** of device **10** are housed in housing sections **51,52**, respectively, and preferably coupled to one another through a coupling structure or "bridge" **50**. This structure provides adequate platforms spacing for a desired riding position, maintains the wheels in a parallel relationship, provides adequate structural support, and affords fore-aft tilt angle movement of the two platform sections **20,30**. Seam or gap **15** is visible where the two housing sections **51,52** meet externally.

[0018] FIG. **2** is a partial cut-away view that shows the inter-coupling of the left side housing **51** with the right side housing **52**. Housing **52** has a sheath **54** that extends into a sheath recess **53** in housing **51**. The sheath is secured to housing **51** via an annular protrusion **55** that fits into a complementary recess **56**. Battery **48** is preferably provided within the volume (or cavity **49**) within sheath **54**.

[0019] In conventional hover board embodiments, such as that of the '278 patent, the wheels are outside of the foot platforms. This causes the weight of a rider to exert a considerable force on the coupling structure. The present invention recognizes that by placing the wheels under the platforms, the weight of the rider is no longer exerted on the coupling structure (it is exerted directly downward onto the wheel), eliminating the need for larger bearings and support structures in the bridge. The elimination of these components yields sufficient space in coupling structure **50** to house battery **49**, which then frees up space under the platforms (where the battery is located conventionally) for the wheels. This achieves the desired more compact form.

[0020] Furthermore, reducing bearing size and structural support also reduces manufacturing costs, overall device weight, and shipping costs, etc.

[0021] Housing recess **53**, sheath **54**, protrusions **55** and complementary recess **56** may be made of or coated with a low-friction high-wear nylon or similar substance for long duration, low friction movement of the left and right foot platforms (and housing sections **51,52**) relative to one another.

[0022] FIG. **3** illustrates, in partial cross-section, device **10** of FIGS. **1-2** yet with an alternative bearing arrangement **61**. Bearing arrangement **61** includes an extension **62** from housing section **51** that fits around sheath **54** and couples via ball bearings **64** in recess **66**. The extension, ball bearings and recess are provided annularly around sheath **54**. The design of device **10** allows use of a lighter weight ball bearing arrangement than in prior art devices.

[0023] FIGS. **4** and **5** show an alternative embodiment for coupling the two platform sections. In device **110**, housing